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Please replace the paragraph [0035], with the following amended paragraph:

Typically, bandpass filters are used to recover signals at the frequency of interest and block signals of unwanted frequencies. Performance characteristics of bandpass filters include the bandwidth of the passband (e.g., 410, 420, and 430), the bandwidth of the stopband (e.g., 458, 460, and 462), the "sharpness" of the filter which is often defined as the slope of the transition region and the percent of energy of frequencies outside the stopband that are effectively blocked. Signals operating in the passband typically pass 100 percent of the signal, e.g., do not attenuate the signal. As illustrated in Fig. 4, the passband for an analog filter 410 is shown from 404 to 406 and the associated stopband 458 is from the frequency at 446 to the frequency at 448. For the analog filter shown, signals at frequencies outside of the stopband only pass 0.1 – 0.01 percent of the signal or attenuate 99.9 – 99.99 percent of the signal. The analog filter has a wide range of frequencies between the passband and the stopband. This frequency range is referred to as the transition region, represented as one example for filter 410 in Fig. 4 as line 444 and line 408 446. Signals with frequencies within the transition region are attenuated by various levels based on the slope of the transition region curve. The more signal attenuated at a particular frequency or the smaller the desired transition region, the larger and more complex the analog filter required, hence the more components required and increased cost.

Please replace the paragraph [0053], with the following amended paragraph:

Compatible operating frequencies are often chosen due to the limitations of the analog filters to attenuate frequencies outside of their passband. Adjacent analog filters provide a separation band 412, such that the lower adjacent filters only pass a predefined tolerance level of the signal associated with frequencies that overlap with an adjacent higher frequency filter. In this illustration, a typical overlap intersection at the 10 percent level is shown by point 417 446. In this example, a system operating with an 86 Hz bandpass filter would allow 10% of a signal at frequency 422 (which is the lower passband

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frequency of the 114 Hz filter) to pass through. With a noise threshold of 1%, this means that approach track circuits operating at 114 Hz are not compatible with overlapping approach track circuits at 86 Hz. As a result, the next higher or lower frequency would need to be used. Operating systems require that an adjacent operating track circuit not have an overlap of its filter passband above the 1% noise threshold with an adjacent operating track circuit. As such, the operating frequency 402 with filter 410 could not be utilized in the same vicinity as operating frequency 420. The next compatible operating frequency with frequency 402 would be operating frequency 428 with bandpass filter 430 with a passband from 432 to 434. In this case, it can be seen that filter 430 transition band 436 intersects filter 410 passband 406 below the 1% noise threshold. However, the utilization of operating frequency 428 may not be the optimal choice for that deployment, as it may not provide the necessary or desired surveillance distance required by maximum speed trains in that area.

Please replace the paragraph [0055], with the following amended paragraph:

An additional improvement is the increased signal to noise ratio of the signal that is provided to the signal detection system. By providing a strong signal with higher signal to noise ratio within the frequencies of the passband, the detection of the signal characteristics significantly improves. The detection system has a cleaner signal to analyze and to make determinations of the voltage and current of the transmitted operating signal, and therefore the determination of the impedance. Another improvement of the present system is that the separation band between operating frequencies can be reduced due to the increased slope of attenuation in the transition region. As shown in Fig. 5, the level of overlap between the first filter 510 and the second filter 520, as indicated by point 515 546 occurs below the noise threshold level of 1% indicated by 565.

Please replace the paragraph [0059], with the following amended paragraph:

Another improvement according to one aspect of the present invention results from both the reduction in the passband bandwidth and the required separation bandwidth, e.g.,

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the reduction in the bandwidth of the associated filter stopband (e.g., 553, 560, and 562). By reducing the stopband associated with each filter, frequencies that are significantly closer together now become compatible for use in adjacent systems. Referring again to Fig. 5, intersection of upper passband 510 ~~506~~ of frequency 402 and transition band 516 ~~514~~ of frequency 418 occurs below the 1% noise threshold. As such, an operating frequency that is less than frequency 418 could be utilized as an operating frequency and still be compatible with the track circuit utilizing frequency 402 whereas in prior art even frequency 418 was not compatible with frequency 402 in overlapping approaches.

Please replace the paragraph [0075], with the following amended paragraph:

Similarly, a second digital signal processor (DSP B) 654 generates a sine wave output signal 656 to a second sine wave generator 658 to produce an island sine wave signal 660. Island sine wave signal 660 ~~560~~ is provided to island transmitter 664 that amplifies the island sine wave signal 660 based on island gain control signal 663 provided by the second DSP 654. This amplified island signal is transmitted onto rail 102 via the isolated transmitter leads 113A and 113B. Of course in different embodiments, the island track circuit 110 may utilize the same set of transmit leads.

Please replace the paragraph [0077], with the following amended paragraph:

The approach track circuit 602 generates feedback 612 indicative of the voltage transmitted along the rail 102, and a feedback 678 indicative of the transmitted current. Differential amplifiers can be used to provide the transmitted voltage feedback 612 and the transmitted current feedback 678. For example, a differential input amplifier 607 is connected to lead 112A and lead 112B, and the output provides feedback voltage 612 representing the voltage of the transmitted approach signal. A resistor 609 is interposed in series with output lead 112B, and a differential input amplifier 611 has its inputs connected to the respective ends of resistor 609 in order to provide a ~~a~~ feedback current signal 678 representative of the value of the constant current applied to the track. A received voltage feedback 614 represents the transmitted approach signal voltage picked up by the receiver

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via leads 116A and 116B. In one embodiment, the receiver 615 is another differential input amplifier having its inputs connected to the tie points 116A and 116B, and the output signal from amplifier is a voltage representative of the received approach signal.

Feedbacks 612, 678 and 614 are provided to the data acquisition system 617 comprised of a track circuit feedback 616, anti-alias filter 618, and multiplexer 620. As known to those skilled in the art, multiplexing involves sending multiple signals or streams of information at the same time in the form of a single, complex signal (i.e. multiplex signal). In this case, the anti-alias filter 618 receives the transmitted voltage feedback 612, the transmitted current feedback 678, and the received voltage feedback 614 to eliminate, for example, noise in the received feedback signals. The multiplexer 620 is coupled to the anti-alias filter and multiplexes the filtered first transmitted voltage feedback 612, the filtered first transmitted current feedback 678, and the filtered first received voltage feedback 614 to generate a multiplexed analog signal 622. The multiplexed analog signal 622 is provided to an analog to digital converter 662 where the analog signal is sampled and digitized and converted into first digital signals that correspond to the transmitted voltage feedback 612, the transmitted current feedback 678, and the received voltage feedback 614. The first digital signals are digitally bandpass filtered within the DSP 604 and the filtered data is processed to determine signal level and phase. In particular, the first digital signals are processed to determine the frequency and magnitude of the transmitted voltage feedback 612, the transmitted current feedback 678, and the received voltage feedback 614.

Processing the ~~second~~ first digital signals also includes digitally filtering the second digital signals to determine if the frequency of the received voltage feedback 614 is within a first passband range. If the received voltage feedback 614 is determined to be within a first passband range, the DSP 604 uses the determined signal level (i.e., magnitude) and phase data to calculate the overall track impedance, which in turn determines the presence and motion of a train within the approach track circuit 128. In an alternate embodiment, the DSP 604 provides the data that includes the signal level and signal phase to a different processor (not shown) that calculates the overall track impedance, which in turn determines the presence and motion of a train within the approach track circuit 128.